**SECTION 15081 - DUCT INSULATION**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes duct and equipment insulation.

1.2 DEFINITIONS

A. Hot Surfaces: Normal operating temperatures of 100 deg F (38 deg C) or higher.

B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.

C. Cold Surfaces: Normal operating Temperatures less than 75 deg F (24 deg C).

D. Thermal Resistivity: "r-values" represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1" (25.4 mm) thick.

E. Density: Is expressed in $lb/ft^3$ ($kg/m^3$).

1.3 QUALITY ASSURANCE

A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.
   1. Interior Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.

1.4 SEQUENCING AND SCHEDULING

A. Schedule insulation application after testing of duct systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:
1. Glass Fiber:
a. Certain Teed Corporation.
b. Knauf Fiberglass.
c. Manville/Schuller.
d. Owens-Corning Fiberglas Corporation.
e. USG Interiors, Inc. - Thermafiber Division.

2.2 GLASS FIBER

A. Material: Inorganic glass fibers, bonded with a thermosetting resin.

B. Jacket: All-purpose, factory-applied, laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil having self-sealing lap.

C. Board: ASTM C 612, Class 2, semi-rigid jacketed board.
1. Thermal conductivity: 0.0188tu-ft/hr-ft²-°K) average maximum, at 75 deg F (24 deg C) mean temperature.
2. Density: 6lb/ft³ (96 kg/m³) average maximum.

D. Blanket: ASTM C 553, Type I, Class B-2, jacketed flexible blankets.
1. Thermal Conductivity: 0.023 Btu-ft/hr-ft²-°F (0.039 W-m/m²-°K) at compressed thickness, at 75 deg F (24 deg C) mean temperature.
2. Density: 3/4 lb.ft³ (12kg/m³).

E. Adhesive: Produced under the UL Classification and Follow-up service.
1. Type: Non-flammable, solvent-based.
2. Service Temperature Range: -20 to 180 deg F (-30 to 82 deg C).

2.3 INSULATING CEMENTS

A. Mineral Fiber: ASTM C 195.
1. Thermal Conductivity: .083 Btu-ft/hr-ft²-°F (.144 W-m/m²-°K) average maximum at 500 deg F (260 deg C) mean temperature.
2. Compressive Strength: 10 psi (70 kPa) at 5 percent deformation.

B. Mineral Fiber, Hydraulic-Setting Insulating and Finishing Cement: ASTM C 449.
1. Thermal Conductivity: .098 Btu-ft/hr-ft²-°F (0.17 W-m/m²-°K) average maximum at 1200 deg F (660 deg C) mean temperature.
2. Compressive Strength: 100 psi (690 kPa) at 5 percent deformation.

2.4 ADHESIVES

A. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:
   1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.
   2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

2.5 JACKETS

A. Foil and Paper Jacket: Laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
   1. Water Vapor Permenance: .02 grains/h-ft²-in. Hg (1.15 ng/(s.m.².Pa) maximum, when tested according to ASTM E 96.
   2. Puncture Resistance: 50 beach units minimum, when tested according to ASTM D 781.

B. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20 mil (.51 mm thick), high-impact, ultra-violet-resistant PVC.
   1. Adhesive: As recommended by insulation manufacturer.

2.6 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, presized a minimum 8 oz./yd² (270 g/m²)yd.
   1. Tape Width: 4" (100 mm).
   2. Cloth Standard: MIL-C-20079H, Type I.
   3. Tape Standard: MIL-C-20079H, Type II.

B. Bands: 3/4" (20 mm) wide, in one of the following materials compatible with jacket:
   1. Aluminum: 7 mils (0.178 mm) thick.
   2. Brass: 10 mils (0.25 mm thick).

C. Wire: 14-gage (2.9 mm) nickel copper alloy, 16-gage (1.6 mm), soft-annealed stainless steel, or 16-gage (1.6 mm), soft-annealed galvanized steel.

D. Corner Angles: 28-gage (0.47 mm), 1" by 1" (25mm by 25 mm) aluminum, adhered to 2" by 2" (50 mm by 50 mm) kraft paper.

E. Anchor Pins: capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

2.7 SEALING COMPOUNDS

A. Vapor Barrier Compound: Water-based, fire-resistive composition.
   1. Water Vapor Permeance: .08 grains/h-ft²-in. Hg (4.6 ng/ (s.m.² .Pa) maximum.
   2. Temperature Range: -22 to 175 deg F (-30 to 80 deg C).

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean, dry, and remove foreign materials such as rust, scale, and dirt.

B. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless-steel surfaces with demineralized water. Follow cement manufacturer's printed instructions for mixing and portions.

3.2 INSTALLATION, GENERAL

A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical system.

B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.

C. Install vapor barriers on insulated ducts and equipment having surface operating temperatures below 60 deg F (15 deg C).

D. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.

E. Install insulation with smooth, straight, and even surfaces.

F. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.

G. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

H. Seal Ends: Taper ends at 45 degree angle and seal with lagging adhesive.

I. Apply adhesives and coating at manufacturer's recommended coverage-per-gallon rate.

J. Keep insulation materials dry during application and finishing.

K. Items Not Insulated: Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:
1. Metal ducts with duct liner.
2. Flexible connectors for ducts and pipes.
3. Testing laboratory labels and stamps.
4. Nameplates and data plates.
5. Access panels and doors in air distribution systems.

3.3 EQUIPMENT INSULATION INSTALLATION, GENERAL

A. Install board and block materials with a minimum dimension of 12" (300 mm) and a maximum dimension of 48" (1200 mm).

B. Groove and score insulation materials as required to fit as closely as possible to the equipment and to fit contours of equipment. Stagger end joints.

C. Insulation Thicknesses Greater than 2" (50 mm): Install insulation in multiple layers with staggered joints.

D. Bevel insulation edges for cylindrical surfaces for tight joint.

E. Secure sections of insulation in place with wire or bands spaced at 9" (225 mm) centers.

F. Protect exposed corners with corner angles under wires and bands.

G. Manholes, Handholes, and Information Plates: Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.

H. Removable Insulation: Install insulation on components that require periodic inspecting, cleaning, and repairing for easy removal and replacement without damage to adjacent insulation.

I. Finishing: Where indicated, apply 2 coats of vapor barrier compound to a minimum thickness of .06" (1.56 mm). Install a layer of glass cloth embedded between layers.

3.4 GLASS FIBER EQUIPMENT INSULATION INSTALLATION

A. Secure insulation with anchor pins and speed washers.

B. Space anchors at maximum intervals of 2" (50 mm) in both directions and not more than 3" (75 mm) from edges and joints.

C. Apply a smoothing coat of insulating and finishing cement to finished insulation.

3.5 DUCT INSULATION

A. Install block and board insulation as follows:
   1. Adhesive and Band Attachment: Secure block and board insulation tight and smooth with at least 50 percent coverage of adhesive. Install bands spaced 12" (300 mm) apart. Protect insulation under bands and at exterior corners with metal corner angles. Fill joints, seams, and chipped edges with vapor barrier compound. Install metal corner angles on all outside corners to provide a neat finished appearance.
   2. Speed Washers Attachment: Secure insulation tight and smooth with speed washers and welded pins. Space anchor pins (18" (450 mm) apart each way and 3" (75 mm) from insulation joints. Where indicated, apply vapor barrier coating compound to insulation in contact, open joints, breaks, punctures, and voids in insulation.

B. Blanket Insulation: Install tight and smooth. Secure to ducts having long sides or diameters as follows:
   1. Smaller Than 24" (600 mm): Bonding adhesive applied in 6" (150 mm)-wide transverse strips on 12" (300 mm) centers.
   2. 24" (600 mm) and Larger: Anchor pins spaced 12" (300 mm) apart each way. Apply bonding adhesive to prevent sagging of the insulation.
   3. Overlap joints 3" (75 mm).
   4. Seal joints, breaks, and punctures with vapor barrier compound.

## 3.6 JACKETS

A. Foil and Paper Jackets (FP): Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1 1/2" (40 mm) laps at longitudinal joints and 3" (75 mm)-wide butt strips at end joints. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound.

B. Install glass cloth jacket directly over insulation. On insulation with a factory applied jacket, install the glass cloth jacket over the factory applied jacket. Install jacket drawn smooth and tight with a 2" (50 mm) overlap at joints. Embed glass cloth between (2) 0.061" (1.56 mm)-thick coats of lagging adhesive. Completely encapsulate the insulation with the jacket, leaving no exposed raw insulation.

## 3.7 INSULATION SCHEDULES

A. General: Abbreviations used in the following schedules include:
   1. Materials: GF - Glass Fiber.

B. Duct Systems

| ***APPLICATION*** | ***FORM*** | ***MATERIAL*** | ***THICKNESS*** | ***VAPOR BARRIER*** | ***FIELD-APPLIED JACKET*** |
|---|---|---|---|---|---|
| MEDIUM VELOCITY SUPPLY DUCTS-FANS (DISCHARGE TO VAV TERMINAL INLET) | BLANKET | GF | 1 1/2" (40 mm) | YES | NONE |
| LOW VELOCITY RETURN AIR DUCTS | BLANKET | GF | 1 1/2" (40 mm) | NO | NONE |
| LOW VELOCITY DUCTS (DOWNSTREAM OF VAV TERMINALS AND RETURN AIR DUCTS) | BLANKET | GF | 1 1/2" (40 mm) | YES | NONE |
| OUTSIDE AIR DUCT FROM INTAKE TO AIR HANDLING UNIT CONNECTION | BOARD | GF | 2" (50 mm) | YES | CANVAS |

END OF SECTION 15081